Jananayak Chandrashekhar University Ballia

New

Faculty of Science

Department of Physics

Syllabus

(W.E.F. 2022-2023)

Jananayak Chandrashekhar University Ballia

Department of Physics

Syllabus

Programme: M. Sc. (Physics)

Programme Outcomes: The Focused outcomes of Master's degree program in Physics are:

- To build a creative and stimulating environment conducive for teaching and research.
- To impart high quality Physics education and equip students for global Physics competence.
- To promote research and creative activities among faculty and students.
- To sensitize students to contribute for the welfare of society through competence in Physics.
- Advanced knowledge of Physics in the core areas of Classical Physics, Mathematical Physics, Statistical physics, and Quantum mechanics.
- Proficiency in multiple allied areas of physics such as Condensed Matter Physics, Particle physics, Nuclear Physics, Spectroscopy and Electronics.
- Advanced ability in techniques of scientific computing to solve problems.
- Their ability to present information clearly, logically, truthfully and critically, both in verbal and written communication.
- Both an understanding and the practical application of ethical standards implicit in science as well as scientific temperament in public and private life,
- Their competence for Doctoral study in physics and/or careers in scientifically oriented jobs in the public or private sector.

Programme Structure: The structure of programme is as following:

- The Post-Graduation programme in Physics offers in four semesters (2 years) system.
- The entire programme is 2300 marks and 100/101 credits.
- Each semester will have 5 (4 theory and 1 practical) papers and one project of 4 credits and 100 marks of theory and practical each except project.
- The student will have to complete a project of 4 credits in each semester (total -16 credits in 4 semesters) under the supervision of a supervisor.
- There may be a co-supervisor also from any industry, company, technical or research institute.
- The projects reports carried out in 1^{st} and 2^{nd} semesters and 3^{rd} and 4^{th} semesters will be submitted in second and fourth semester before/after examination. Both projects will be evaluated out of 100 marks (8 credits) by the supervisor and the external examiner appointed by the University at the end of the first and second year respectively.
- In 1^{st} or 2^{nd} semester, the student will have to opt for a minor elective paper of 4/5 credits from a faculty other than their own faculty.

The course structure of the programme to be taught in each semester is given below:

Prof. A.N. Singh

M.Sc. I

I Semester

Sr.No	Paper	Name of The Paper	Course Code	Teaching Hours	Credit	Marks
1.	I	Mathematical Physics	PHY101	60	04	100
2.	II	Classical Mechanics	PHY102	60	04	100
3.	III	Quantum Mechanics-I	PHY103	60	04	100
4.	IV	Electromagnetic Theory Practical	PHY104	60	04	100
5.	V	Practical	PHY105	60	04	100
6.	VI	Project I	PHY 106		04	
			Total	*300*	*24*	*500*

M.Sc. I

II Semester

Sr.No	Paper	Name of The Paper	Course Code	Teaching Hours	Credit	Marks
1.	I	Atomic and Molecular Physics	PHY 201	60	04	100
2.	II	Condensed Matter Physics	PHY 202	60	04	100
3.	III	Quantum Mechanics-II	PHY 203	60	04	100
4.	IV	Electrodynamics and Plasma Physics	PHY 204	60	04	100
5.	V	Practical	PHY 205	60	04	100
6.	VI	Project II	PHY 206		04	100*
7.		One Minor Elective paper from other faculty in 1st or 2nd Semester		60	04/05	100
			Total	*360*	*28/29*	*700*
			Grand Total M.Sc. I	*660*	*52/53*	*1200*

- *The projects reports carried out in 1st and 2nd semesters will be submitted in second semester before/after examination. Both projects will be evaluated out of 100 marks (8 credits) by the supervisor and the external examiner appointed by the University at the end of the first year.
- One of the projects reports (1st or 2nd semesters) will also presented in form of PPT in second semester before/after examination.
- In 1st or 2nd semester, the student will have to opt for a **minor elective paper** of 4/5 credits from a faculty other than their main faculty.

Stripathi Prof. A.H. Singh

M.Sc. II

III Semester

Sr.No	Paper	Name of The Paper	Course Code	Teaching Hours	Credit	Marks
1.	I	Lasers and Opto electronics	PHY 301	60	04	100
2.	II	Nuclear Physics-I	PHY 302	60	04	100
3.	III	Electronics-I	PHY 303	60	04	100
4.	IV	Electronics-II	PHY 304	60	04	100
5.	V	Practical	PHY 305	60	04	100
6.	VI	Project II	PHY 306		04	
			Total	*300*	*24*	*500*

M.Sc. II

IV Semester

Sr.No	Paper	Name of The Paper	Course Code	Teaching Hours	Credit	Marks
1.	I	Statistical Mechanics	PHY 401	60	04	100
2.	II	Nuclear Physics-II	PHY 402	60	04	100
3.	III	Electronics-III	PHY 403	60	04	100
4.	IV	Electronics-IV	PHY 404	60	04	100
5.	V	Practical	PHY 405	60	04	100
6.	VI	Project II	PHY 406		04	100*
			Total	*300*	*24*	*500*
			Grand Total M.Sc. II	*600*	*48*	*1100*
			Grand Total (For Semester I,II,III and IV)	*1260*	*100/101*	*2300*

- *The projects reports carried out in 3rd and 4th semesters will be submitted in fourth semester before/after examination. Both projects will be evaluated out of 100 marks (8 credits) by the supervisor and the external examiner appointed by the University at the end of the second year.
- One of the projects reports (3rd or 4th semesters) will also presented in form of PPT in second semester before/after examination.

Stripathi Prof. A. N. Singh

M.Sc. (Physics) I Year
I Semester
Department of Physics

Course Title: MATHEMATICAL PHYSICS
Course Code: PHY-101
Type of course: Core (Theory)
Credits: 04 (Theory: 60 Hours)

Max. Marks: 100

Course Objectives: To introduce students to methods of mathematical physics and to develop required mathematical skills in the area of Matrix Analysis, Complex variables, Tensors, Fourier Transformation & Polynomialsto solve problems in theoretical physics.

Unit-I Matrix Analysis

Definition and types of matrix, conjugate of a matrix, algebraic operation on matrices, Hermitian and anti- Hermitian matrices, determinant of a square-matrix, inverse of a matrix, solution of linear equation, transformation matrices, rank and diagonalization of matrix.

Unit-2 Complex Variables

Definition of complex number, analyticity of complex function, Cauchy-Riemann condition, Cauchy's Integral theorem and formula, Zeroes, poles and singular points. Contour Integration, Residue theorem.

Unit-3 Tensors

Definition of a tensor in three dimensions and four dimensional space, rank of tensor addition, multiplication, contraction of tensors, Covariant and contra variant tensors. Pseudo tensors. Symmetry and anti-symmetric properties of tensor, tensors densities.

Unit-4 Fourier Transformation & Polynomials

Fourier Transformation: Definition, Fourier series, FS for arbitrary period, Fourier Sine and Cosine transform, Application of Fourier-Transform.
Polynomials: Bessel and Legendre functions and polynomials, Rodrigue's formula for Legendre polynomial Orthonormality and other properties of Legendre, Associated Legendre, Hermit, Laguerre and Associated Laguerre polynomial.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Mathematical methods for Physicist: G. Artken
2. Matrices and Tencer in physics by A.WJoshi
3. Elements of Complex variable: Churchill

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M.Sc. (Physics) I Year
I Semester
Department of Physics

Course Title: CLASSICAL MECHANICS
Course Code: PHY-102
Type of course: Core (Theory)
Credits: 04 (Theory: 60 Hours) **Max. Marks: 100**

Course Objectives: Aim of this advanced level course on classical mechanics is to polish the learner's understanding of the subject, to learn how complex classical systems could be formulated and solved using the Hamiltonian by observing symmetries of the system and/or through advanced co-ordinate transformation techniques such as canonical transformations of various kinds and action-angle variable technique.

Unit-I

Mechanics of a system of particles, Generalized Coordinates, D Alembert's principle. The Lagrangian formulation and equations of motion (with full derivation). The Hamiltonian formulation and equations of motion (with full derivation).

Unit-II

Calculus of variations and its application - Hamilton's principle. The modified Hamilton's principle and principle of least action, the rigid body motion - Euler angles, Motion of symmetrical top.

Unit-III

Canonical transformations, Poisson brackets, Equations of motion and infinitesimal canonical transformations in the Poisson bracket formulation, Liouville's theorem.

Unit-IV

Hamilton - Jacobi equations, Action angle variables, the connection between HamiltonJacobi theory and geometrical optics, Theory of small oscillations - Free vibrations of linear tri- atomic molecule.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Classical Mechanics: N C Rana& P S Joag, TMH 1991
2. Classical Mechanics: H Goldstein, Addison Wasley, 1980

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M.Sc. (Physics) I Year
I Semester
Department of Physics

Course Title: QUANTUM MECHANICS-I
Course Code: PHY-103
Type of course: Core (Theory)
Credits: 04 (Theory: 60 Hours) **Max. Marks: 100**

Course Objectives: To acquire working knowledge of the Non-relativistic Quantum Mechanics and apply mathematical formulation developed for the quantum mechanical systems on the physical systems.

Unit-I

FundamentalsUncertainty principle and applications, Schrodinger wave equation, normalization, probability current density, expectation values, Ehrenfest theorem, energy eigen function and eigen values, separation of time dependent wave equation, stationary states, boundary and continuity conditions, dynamical variables as operators, hermitian operators and their properties, Orthonormality, free particle solution. One dimensional step potential (finite and infinite) particle in one dimensional square potential well (finite and infinite) parity, linear harmonic oscillator, zero point energy, rectangular potential barrier.

Unit-2

Three Dimensional SystemParticle in three dimensional box, Dirac delta functions, orbital angular momentum, commutation relations, central force problems, solution of Schrodinger equation for spherical symmetric potentials, Hydrogen atom- reduced mass, wave function, energy levels, degeneracy, Energy Eigen function and Eigen values of three dimensional harmonic oscillator, and rigid rotator.

Unit-3

Matrix, formulation of quantum theory, linear vector space, vector and operators and their matrix representation, bra and ket notations, projection operator, unitary transformation, matrix theory of linear harmonic oscillator, raising and lowering operators eigen values and eigen functions of L2 and Lx, spin, Pauli spin matrices, and their algebra, matrices for J2 and Jx, addition of two angular momenta, (elementary discussion).

Unit-4

Time independent perturbation theory for non degenerate case, formulation upto second order, perturbation of linear harmonic oscillator- (i) estimation of correction up to second order for perturbation term depending on x and x2 (ii) first order correction to energy by x3 and x4 type terms, Ground state of Helium atom, Stark effect of a plane rigid rotator.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Quantum Mechanics: L I Schiff, TMH
2. Quantum Mechanics: S gasioriwiez, Wiley
3. Quantum Mechanics by P.A.M.Dirac
4. Quantum Mechanics: Mathews and Ventesan

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M.Sc. (Physics) I Year
I Semester
Department of Physics

Course Title: ELECTROMAGNETIC THEORY
Course Code: PHY-104
Type of course: Core (Theory)
Credits: 04 (Theory: 60 Hours) **Max. Marks: 100**

Course Objectives: To gain an understanding of Maxwell's equations and the ability to apply them to explain the behaviour of electromagnetic wave propagation in different media, phenomenon of refraction, reflection, scattering, interference, diffraction and polarization

Unit -1
Maxwell's Equations in vacuum and matter, Maxwell's correction to Ampere's law for nonsteady currents and concept of Displacement current; Boundary conditions, Poynting's theorem, Conservation of Energy and momentum for a system of charged particles and electromagnetic field.

Unit-II
Vactor and scalar potentials, Maxwell's Equations in terms of Electromagnetic Potentials, Electromagnetic wave equation, Non-uniqueness of Electromagnetic Potentials and Concept of Gauge. Gauge Transformations: Coulomb and Lorentz Gauge; Green's Function for the Wave Equation; Transformation Properties of Electromagnetic Fields and Sources under Rotation, Spatial Reflection and Time- Reversal.

Unit-III
Propagation of Electromagnetic Plane Waves in Vacuum, Non-conducting Medium, Conducting Medium and Plasma; Reflection, Refraction and Polarization of Electromagnetic Waves, Stokes Parameters; Frequency Dispersion Characteristics of Dielectrics and Conductors; Normal and Anomalous Dispersion, Spreading of Pulse in Dispersive Media, Kramer-Kronig Relations.

Unit-IV
Propagation of Electromagnetic Waves in Rectangular Waveguides, TE and TM Modes, Cut off frequency, Energy Flow and Attenuation. Modal Analysis of guided modes in a cylindrical waveguide. Field and Radiation due to an Oscillating Electric Dipole. Magnetic dipole and electric quadrupole fields.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Electromagnetic Theory by Julius Adams Stratt
2. Electromagnetic Field Theory by V.A.Bakshi, A.V.Bakshi

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M.Sc. (Physics) I Year
I Semester
Department of Physics

Course Title: PRACTICAL
Course Number: PHY-105
Type of course: Core (Practical)
Credits: 04 (Theory: 60 Hours) **Max. Marks: 100**

Course Objectives: To develop experimental skill in various Techniques

1. Hysteresis Curve (a) by Ballistic method and (b) by Oscillograph
2. FET/MOSFET
3. Ultrasonic Diffraction
4. Michelson Interferometer
5. Elastic constant by Newton's Ring
6. Hall Effect
7. Use of constant deviation spectrograph
8. Q of coil

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M.Sc. (Physics) I Year
II Semester
Department of Physics

Course Title: ATOMIC AND MOLECULAR PHYSICS
Course Number: PHY-201
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To develop basic theoretical knowledge in Atomic, Molecular Spectra and Diatomic spectra Physics.

Unit-I Atomic Phvsics

Quantum states of one-electron atoms, atomic orbital, hydrogen spectrum, Pauli's principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra- equivalent, non-equivalent electrons.

Unit-2 Atomic Spectra
Normal and anomalous Zeeman effect, Paschen Back effect, stark effect, two electron system, interaction energy in LS and JJ coupling, hyperfine structure (qualitative).

Unit-3 Diatomic-Molecular Spectra
Rotational spectra of diatomic molecules as a rigid rotator, Energy levels and spectra of nonrigid rotator, Intensity of spectral lines.

Unit-4 Energy of Molecules
Vibrational energy of diatomic molecules, diatomic molecules as a simple harmonic oscillator, Energy level and spectrum, Mores potential energy curve, Molecules as vibrating rotator, vibrational spectrum of diatomic molecules, PQR branches.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Introduction to atomic spectra, H E White (T)
2. Fundamental of molecular spectroscopy, C W Banwell (T)
3. Introduction to molecular spectroscopy, G M Barrow
4. Spectra of diatomic molecules, Herzberg

M.Sc. (Physics) I Year
II Semester
Department of Physics

Course Title: CONDENSED MATTER PHYSICS
Course Number: PHY-202
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To make aware students about the useful concepts of condensed matter physics at post graduate level. These include symmetry operations, crystal defects, reciprocal lattice, semiconductors, magnetism and superconductivity

Unit-I Crystal Phvsics
Crystalline solids, unit cell and direct lattice, Miller indices of planes and axes, two and three dimensional Bravais lattices, closed packed structures, Braggs law, experimental diffraction techniques, construction of reciprocal lattice, reciprocal lattice vector, Brillouin zone and atomic fact or.

Unit-2 Point Defect and Imperfection
Point defect, line defect and planer stacking fault, the role of dislocation in plastic deformation and crystal growth, the observation of imperfection in crystal, X-ray and electron microscopic techniques.

Unit-3 Electronic Energy Bands
Electrons in periodic lattice, Bloch theorem, Band theory, classification of solids, effective mass, tight binding, cellular and pseudopotential method.

Unit-4 Superconductivitv
Superconductivity: Critical temperature, persistent current, Meissner effect, type I and type II superconductors, heat capacity, energy gap, isotopic effect, London's equation, coherent length.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Verma and Shrivastava: Crystallography for Solid State physics
2. Aschroff and Mermin: Solid State physics
3. Kittel: Solid State physics

M.Sc. (Physics) I Year
II Semester
Department of Physics

Course Title: QUANTUM MECHANICS II
Course Number: PHY-203
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To impart knowledge to make the students able to pursue research in theoretical physics in general and to the fields of nuclear physics, particle physics and astrophysics in particular.

Unit-I
Variational method, Wentzel Kramer Brillouin (WKB) approximation, Time-dependent perturbation theory, Harmonic perturbation, Fermi's golden rule, Adiabatic and sudden approximation.

Unit-2
Collision in 3-D and scattering, Laboratory and CM reference frames, scattering amplitude, differential scattering cross section and total scattering cross section, scattering by spherically symmetric potentials, partial waves and Phase shifts, scattering by perfectly rigid sphere and by square well potential and absorption. Born approximation for scattering. Scattering by coulomb potential.

Unit-3
Identical particles, symmetric and antisymmetric wave functions, Collision of identical particles, Spin angular momentum, Spin function for a many electron system.

Unit-4
Semi classical theory of radiation, Quantum Theory of radiation, Relativistic theory, The Klein-garden equation, The Dirac equation, covariance of Dirac equation, energy level of hydrogen atoms, hole theory and positrons.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. L I Schiff, Quantum Mechanics (Me Graw Hill)
2. B Craseman and J D Powell, Quantum Mechanics (Addison Western)
3. J J Sakurai, Modern Quantum Mechanics
4. Mathews and Venktesan, Quantum Mechanics

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M.Sc. (Physics) I Year
II Semester
Department of Physics

Course Title: ELECTRODYNAMICS AND PLASMA PHYSICS
Course Number: PHY-204
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: Quantum Electrodynamics (QED) is the quantum field theory of electrodynamics. In essence, it describes how light and matter interacts and is the first theory where full agreement between quantum mechanics and special relativity is achieved. QED represents the quantum counterpart of classical electromagnetism giving a complete account of matter and light interaction and also basic knowledge of Plasma Physics. Objective of the course is to develop basic understanding and skills of the subject of quantum electrodynamics.

Unit-I Retarded Potentials

Retarded potential and Lienard-Wiechert potential, electric and magnetic fields due to a uniformly moving charge and an accelerated charge, Linear and circular acceleration and angular distribution of power radiated Bremssahlung, synchrotron radiation and cerenkov radiation, reaction force of radiation.

Unit-2 Motion of Charged Particles

Motion of charged particles in electromagnetic field: Uniform E and B fields, non- uniform magnetic fields, diffusion across magnetic field, time varying E and B fields, adiabatic invariants: first, second and third adiabatic invariants.

Unit-3 Basics of Plasma

Elementary concepts: Devation of moment equations from Boltzmann equation, plasma oscillations, Debye shielding, plasma parameters, magnetoplasma, plasma confinement, hydro dynamical description of plasma, fundamental equations, hydromagnetic waves, magnetosonic and Alfven waves.

Unit-4 Wave Propagation

Wave phenomena in magnetoplasma: Polarization, phase velocity, group velocity, cutoffs, resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field, Appleton-Hanree formula.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Bittencourt: Plasma Physics
2. Chen: Plasma Physics
3. Jackson:Classicalelectrodynamics

M.Sc. (Physics) I Year
II Semester
Department of Physics

Course Title: PRACTICAL
Course Number: PHY-205
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Practical)

Course Objectives: To develop experimental skill in various Techniques

1. Planck's constant
2. Richardson Equation
3. GM Counter
4. Energy band gap of semiconductor
5. Fourier analysis by CRO
6. Wavelength of Laser light and thickness of wire
7. Excitation energy and wavelength by Frank Hertz
8. Study of Hall effect

M.Sc. (Physics) II Year
III Semester
Department of Physics

Course Title: Lasers and Opto-Electronics
Course Number: PHY-301
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To develop the basic understanding and theoretical concept of laser, linear and non- linear optics and its application

Unit I

Laser theory, Einstein Coefficients, Light Amplification, threshold condition, Laser Rate Equations-two, three and four level systems.

Unit II

Laser power around threshold, optimum output coupling, Line Broadening Mechanisms - Natural, Collision and Doppler, Optical Resonators - Modes of a rectangular cavity and open planar resonator, Modes of a Confocal resonator system, General Spherical resonator, Higher order modes.

Unit III

Essential criterion to observe non linear optical effects. First experimental demonstration of non-linear phenomena. Classical theory of non-linear response in one dimension. Generalization to 3 dimensions.

Unit IV

Non-linear coupling of 3 waves to produce sum and difference frequencies. Manley Rowe relations and their significance. Sum and difference frequency generation when both input frequencies are lasers. Parametric conversion and amplification.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Yariv: Optical Electronics
2. Latekhov: Non linear Spectroscopy

M.Sc. (Physics) II Year
III Semester
Department of Physics

Course Title: Nuclear Physics
Course Number: PHY-302
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To impart knowledge to make the students able to pursue research in experimental and theoretical nuclear physics.

Unit-I

Basic facts about nuclei, Mass and binding energy, Semi-empirical mass formula, Nuclear size determination using mu-mesic X-rays and scattering of fast electrons, Nuclear spin and magnetic moment of nuclei, Molecular beam resonance method, Nuclear resonance absorption and induction method, Electric quadrupole moment

Unit-II

Alpha decay, Experimental results on alpha decay-Alpha spectra and Geiger- Nutall relation, Theory of alpha decay. Beta-spectra, Fermi's theory of beta decay, Sergeant's law, Kurie Plot, Allowed and forbidden transitions, Parity violation in beta-decay, Detection of neutrino.

Unit III

Gamma emission, Multipolarity of gamma rays, Selection rules, Theoretical prediction of decay constants, Estimation of Transition probabilities, Internal conversion, Angular correlation, Nuclear isomerism, Mössbauer Effect.

Unit-IV

Nuclear reactions, Conservation laws, The Q-equation and deduction of nuclear energy levels, Compound nucleus, Bohr hypothesis, Resonance phenomena, Breit- Wigner one level formula, Optical model, Simple discussion of direct reactions, Nuclear fission, Bohr-Wheeler theory of nuclear fission, Controlled chain reaction, Nuclear reactors.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Ghosal: Atomic and Nuclear physics, vol 2
2. D Griffiths: Introduction to elementary particles, Harper and Row, New York, 1987

M.Sc. (Physics) II Year
III Semester
Department of Physics

Course Title: Electronics I
Course Number: PHY-303
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To understand the basic concepts of linear wave shaping, amplifiers, power supplies and integrated circuit Fabrication technology and apply it in experimental Physics and also for various Engineering Applications.

Unit I: Linear Wave Shaping

High Pass and Low Pass RC Networks, Response to Sinusoidal, Step, Pulse, Square wave, Exponential and Ramp Inputs. High pass RC circuit as a differentiator, Criterion for good differentiation, Double Differentiation, Low Pass RC circuit as an Integrator. Laplace Transforms and their application to circuit elements.

Unit II: Amplifiers

Difference Amplifiers, Broadband Amplifiers, Methods for achieving Broadbanding, Emitter Follower at High Frequencies, Operational Amplifiers and its Applications, IC 741, Active Filters.

Unit III: Power Supplies

Electronically Regulated Power Supplies, Converters and Inverters, High and Low Voltage Supplies, Switched Mode Power Supply (SMPS).

Unit IV: Integrated Circuit Fabrication Technology

Basic Monolithic Integrated Circuits, Steps involved in the Manufacture of Monolithic ICs: Epitaxy, Masking, Etching, Diffusion, Metallization, Bonding, Assembling, Package types. Introduction to VLSI techniques.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Robert Boylested and Louis Nashdsky: Electronic devices and circuit theory, PHI, New Delhi
2. Ramakanth A Gayakwad: OP amps & linear integrated circuits, PHI second addition, 1991
3. Jacob Millman: Microelectronics, Mc-Hill international book co, New Delhi, 1990

M.Sc. (Physics) II Year
III Semester
Department of Physics

Course Title: Electronics II
Course Number: PHY-304
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To understand the basic concepts of Digital Electronics with logic hardware, Boolean algebra, multivibrators and counters and registers and its application in experimental Physics

Unit I: Logic Hardware

Transistor as a Switch, Switching times: Definition and Derivation, Storage Time, Delay Time, Turn On Time, Turn Off Time, Charge Control Analysis. Logic Specifications: Fan In, Fan Out, Noise Immunity, Noise Margin, Propagation Delay, Power Dissipation. Logic Families: DTL, DCTL, I2L, ECL, TTL, CMOSL,CML, HTL

Unit II: Number Systems and Boolean Algebra

Binary, Octal and Hexadecimal Number Systems. Binary Arithmetic. Arithmetic Circuits. Binary Codes: Gray, 8421, 2421, 5211. Boolean Variables and Operations, Simplification of Boolean Expressions. Karnaugh Maps.

Unit III: Multivibrators

Astable, Monostable and BistableMultivibrators. Schmitt Trigger. 555 Timer. SR, JK, T and D, J Master Slave Flip flops, Race problem and Edge Trigger JK Flip flop, Preset and Clear Functions.

Unit IV: Counters and Registers

Binary Counters:. Modulus of Counters: Asynchronous and Synchronous Counter Reset Method, Logic Gating Method. Ring Counter. Shift Registers: SISO, PIPO, SIPO, PISO. Universal Shift Register. Tristate Switches, Tristate Registers.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Barrey B Brey: The internal microprocessors 8086/8088, 80186, 80286, 80386, 80486 pentium and Pentium processors architecture, programming interfacing, IVthedn. 1999.
2. Douglas V Hall: Microprocessors and interfacing, programming and hardware, IInciedn. McGraw Hill, 1992.

M.Sc. (Physics) II Year
III Semester
Department of Physics

Course Title: PRACTICAL
Course Number: PHY-305
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Practical)

Course Objectives: To develop experimental skill in various Techniques

1. Study of Characteristic of Amplifier
2. Negative Feedback Amplifier
3. Study of Multivibrator
4. Study of Oscillators
5. Amplitude Modulation & Demodulation
6. NAND and NOR gate as universal gate.
7. D/A and A/D Convertor
8. Characteristics of Operational Amplifier

M.Sc. (Physics) II Year
IV Semester
Department of Physics

Course Title: STATISTICAL MECHANICS
Course Number: PHY-401
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: Aim of this course is to develop an understanding of how the physics laws of statistical systems are formulated from scratch at the classical as well as quantum level with the aid of statistical distributions, and thereby partition function and entropy of the system. In addition the learners also get acquainted with some exotic phenomenon of the nature which are based upon the phase-transitions of various types, random walk, Heisenberg and Ising model for Magnetic materials.

Unit-I Basics of Statistical Mechanics

Origin and Foundation of statistical mechanics, specification of states of a system, contact between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox, phase space, trajectories and density of states, Liouville's theorem.

Unit-2 Ensemble Theory

Micro-canonical, canonical and grand canonical ensembles, partition functions, calculation of statistical quantities.

Unit-3 Statistics

Density matrix, statistics of ensembles, statistics of indistinguishable particles, Maxwell Boltzmann, Fermi-Dirac and Bose Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.

Unit-4 Isling Model

Cluster expansion for a classical gas, virial equation of state, isling model, mean field theories of isling model in one, two and three dimensions, exact solution in one dimension.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Rief: Statistical and Thermal physics
2. K Huang: Statistical mechanics
3. R K Patharia: Statistical mechanics

M.Sc. (Physics) II Year
IV Semester
Department of Physics

Course Title: NUCLEAR PHYSICS II
Course Number: PHY-402
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To impart knowledge in nuclear forces, nuclear models and elementary particles to make the students able to pursue research in experimental and theoretical nuclear physics.

Unit I

Nuclear forces,Nuclear two-body problem, Simple theory of deuteron, Spin dependence and noncentral feature of nuclear forces, Partial wave analysis, Low energy n-p scattering, Scattering length and effective range theory, Low energy p-p scattering, Charge symmetry and charge independence of nuclear forces, Meson theory of nuclear forces.

Unit II

Nuclear models, Evidence of shell structure, magic numbers and spin-orbit coupling, extreme single particle model. Predictions of spin, parity and electromagnetic moments, Collective model-Vibrational and rotational spectra.

Unit III

Classification of elementary particles, Exact conservation laws, Approximate conservation laws: isospin and isospin wave functions for pion-nucleon system,strangeness, parity, time reversal and charge conjugation, CP violation.

Unit IV

Eight fold way, Quarks, Quark-Quark interaction, SU (3) quark model, Magnetic dipole moment of baryons, Masses of hadrons, Basic ideas about the standard model.

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Nuclei and particles by E.Segre
2. Nuclear Physics by RR Roy

M.Sc. (Physics) II Year
IV Semester
Department of Physics

Course Title: ELECTRONICS-III
Course Number: PHY-403
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Theory)

Course Objectives: To understand the basic concepts of amplitude modulator, frequency modulator, Radar and Television and Microwave and Digital communication and apply it in experimental Physics

Unit I: Amplitude Modulator

Modulation .Amplitude Modulation, Spectrum of the modulated signal, Square law Modulator, Balanced Modulator, DSBSC, SSB and vestigial sideband modulation. Limitations of Amplitude Modulation. AM Receiver.

Unit II: Frequency Modulator

Analysis and frequency Spectrum, Generation and Detection of FM. Comparison of AM and FM. Pre-emphasis and De-emphasis. Reactance Modulator. Capture Effect. Varactor Modulator. Amplitude Limiter. FM Receiver. Foster Seely Discriminator. Ratio Detector.

Unit III: Radar & Television

Radar: Principle of radar, Elements of radar system, Peratind characteristics and maximum range of radar set, Duplexer, Radar beacons.
Television: General principle of image transmission scanning sequence and synchronization, Television camera tubes, elements of color television.

Unit IV: Microwave and Digital Communication

Microwave Generator: High frequency generation problems, Klystron amplifier and oscillators, Gunn oscillator and microwave components.

Digital Communication: Sampling theorem, Pulse Modulation: Pulse Code, Pulse Amplitude, Pulse Position Pulse Width Modulation.

Differential PCM, Delta Modulation. Digital Communication System. Digital Carrier System. Frequency Shift Keying. Phase Shift Keying. Differential Phase Shift Keying. Division Multiplexing.
Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Wayne Tomasi: Advanced electronics communications systems, Phi. Edn.
2. Taub and Schilling: Principles of communication systems, second edition TMH, 1990
3. Simon Haykin: Communication systems, third edition, John Wiley and sons, Inc., 1994

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M.Sc. (Physics) II Year
IV Semester
Department of Physics

Course Title: **ELECTRONICS-VI**
Course Number: **PHY-404**
Credits: **04 (Theory: 60 Hours)**
Type of course: **Core (Theory)**

Course Objectives: To impart the basic concepts of Combinational Logic Circuits, Memories, A/D and D/A Converters and Microprocessors and Displays and apply it in experimental Physics

Unit I: Combinational Logic Circuits

Pin out Diagrams, Truth Table and Working. Decoders: l-of-4 IC 74AS139, l-of-16 IC 74154 BCD to Decimal Decoder IC 7445, BCD to Seven Segment Decoder Driver: IC 7447A, 7448.Encoders: Decimal Priority Encoder IC 74147 Multiplexers, Demultiplexers: Demultiplexeral Decoder. Implementation of Boolean Function using multiplexer.

Unit II: Memories

Memory Devices: Read Only Memories, Masked Memory, ROM, Programmable ROM, EPROM. Random Access Memory: Static and Dynamic, Bipolar Ram Cell, Static RAM cell.

Unit III: A/D and D/A Converters

Binary weighted Resistor D/A Converter, Ladder Network D/A Converter. D/A Converter Specifications: Resolution, Accuracy, Linearity, Settling Time, Temperature Sensitivity. Flash A/D Converter, Ramp A/D Converter, Successive Approximation A/D Converter.

Unit IV: Microprocessors and Displays

LED Displays: Common Anode Display FND 507, FND 567.Common Cathode Display FND 500, FND 560. Flat Panel Displays (LCD, Plasmas etc.) and their addressing techniques. Smart Windows. Intel Microprocessors: Historical Perspective. Architecture of Microprocessor a

Assignment: The assignments works belong to theoretical and application based.

Reference Book

1. Barrey B Brey: The internal microprocessors 8086/8088, 80186, 80286, 80386, 80486 pentium and Pentium processors architecture, programming interfacing, IVthedn. 1999.
2. Douglas V Hall: Microprocessors and interfacing, programming and hardware, llndedn. Mc-Graw Hill, 1992.
3. M A Maxidi and J G Mazidi: The 80x86 IBM PC and compatible comp. (Vol. I & II), llndedn. Prentiee-Hall international, 1998.

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M.Sc. (Physics) II Year
IV Semester
Department of Physics

Course Title: PRACTICAL
Course Number: PHY-405
Credits: 04 (Theory: 60 Hours)
Type of course: Core (Practical)

Course Objectives: To develop experimental skill in various Techniques

1. Operational Amplifier as inverting, non-inverting, D-summing Amplifier
2. Study of time 555Series
3. Regulated power Supply
4. Multiplex &Demultiplexs,
5. Study Incoders and decoders and BCD to saving segment.
6. Microprocessor
7. Experiment on Computers programming
8. Study of TTL logic gates

Stripathi Prof. A. H. Singh